Synopsis for Ph.D. in Chemistry

(Appendix- IV)

Title of Research Work

"Synthesis and Studies of Schiff Base coated silver Nanoparticle structured Complex for removal of Heavy Metals from Industrial Wastewater"

"औद्योगिक अपशिष्ट से भारी धातुओं के निष्कासन के लिये शिफ़ क्षार लेपित सिल्वर नैनो कण संरचित संकुल का संश्लेषण तथा अध्ययन"

A
SYNOPSIS

Submitted for the Award of Ph.D. degree of

Maharshi Dayanand Saraswati University, Ajmer

In the Faculty of Science (Chemistry)
By
Miss. Preeti Sharma

Under Supervision of
Dr. V. Uma
Department Of Chemistry
S.P.C. Govt. College, Ajmer

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Appendix – IV

Format for Outline of Proposed Research Work
(To be supplied in duplicate)

1. Name of Scholar (In English) : Preeti Sharma

(In Hindi) : प्रीति शर्मा

2. Title of Research work : "Synthesis and Studies of Schiff Base Coated silver nanoparticle structured Complex for removal of Heavy Metals From Industrial Wastewater"

(in hindi) : "औद्योगिक अपशिष्ट से भारी धातुओं के निष्कासन के लिये शिफ़ क्षार लेपित सिल्वर नैनो कण संरचित संकुल का संश्लेषण तथा अध्ययन"

3. Location : Department of Chemistry SPC.Government College, Ajmer.

4.	Importance of proposed Investigation, Objectives	:	Annexure – 1
5.	Review of work already On the subject	:	Annexure – 2
6.	Research Gaps identified in the proposed filed of investigation	:	Annexure – 3
7.	Major hypothesis , if any	:	Annexure – 4
8.	Research Methodology	:	Annexure – 5
9.	List of references	:	Annexure – 6

Preeti Sharma

Signature of the Candidate

Outline of the Synopsis Approved

Signature of the Supervisor with Seal

Lecturer.....

Samrat Prithviraj Chauhan
Govt. College, Ajmer

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ANNEXURE – 1

IMPORTANCE OF PROPOSED RESEARCH WORK

Toxic heavy metal contamination of industrial wastewater is an important environmental problem. Many industries such as electroplating,pigments, metallurgical processes, and mining and leather industries release various concentrations of heavy metals. The release of various harmful heavy metal ions into the environment has attracted great attention worldwide in recent years because of their toxicity and widespread use. In light of this, it is vital to develop simple, rapid, and efficient methods for monitoring metal ions in the environment.
There are many possible sources of these heavy metal ions. These include wastes from metal plating operations, mining operations, tanneries, fertilizer and textiles industries. These toxic metals can cause accumulative poisoning , cancer and brain damage when found above the tolerance levels.Thus, the removal processes of heavy metals from natural waters and solvents contaminated by heavy metal ions are attractive for environment.

Schiff bases are obtained through the condensation of aldehydes with amine and contain multidentate coordination sites such as O and N donor atom which have high bonding affinity towards many heavy metal ions.
Schiff bases are widely used in the formulating of various type of application, in medical, industrial, agricultural, et al. fields. These Schiff base is coated with silver nanaoparticle by using suitable method.

Nanotechnology is considered as having the potential to play an important role in shaping our current environment by providing new materials,remediation/treatment techniques and sensors for monitoring purposes . For water purification, there is a need for technologies that have the ability to remove toxic contaminants from the environment to a safe level and to do so rapidly, efficiently and within a reasonable costs framework. Thus, the development of novel nanomaterials with increased affinity, capacity and selectivity for heavy metals and other contaminants is an active emerging area of research in the field of nanotechnology. The benefits of using nanomaterials are mainly associated with their large specific surface area and high reactivity.
These nanomaterials can be used to improve water quality and the availability and viability of water resources, such as through advanced filtration, which enables sustainable water reuse, recycling or desalination. A variety of efficient, and cost-effective. Metal nanoparticles have a high specific surface area and a high fraction of surface atoms; have been studied extensively because of their unique physicochemical characteristics including catalytic activity, optical properties, electronic properties, antibacterial properties and magnetic properties.

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The aim of this research project was to synthesise new nanoparticle coated Schiff base ligand .A large number of Schiff bases have been studied for their interesting and important properties, for example, their ability to reversibly bind oxygen , catalytic activity in hydrogenation of olefins and transfer of an amino group, photochromic properties , and adsorbing ability towards some toxic metals .

From all this mentioned information is planned to synthesis some new Schiff base ligands derived from different aldehydes and different amines which is coated by silver nanoparticles by using suitable method . And then using this silver nanocomplex of Schiff base in removal of heavy metals from industrial effluent.

MAIN OBJECTIVES OF RESEARCH WORK

The main objectives of research work would be as following:-

1.Synthesis of Schiff base ligand by the condensation of different aldehydes or ketones with amine.

2.Synthesis of silver nanoparticle and then complexation of silver nanoparticle with Schiff base.

3. Physiochemical analysis (M.P., magnetic momentum, conductance,solubility,pH TLC,) and studies of UV-VIS, IR, NMR, ESR , Mass spectrum and SEM analysis of these ligand and silver nano complexes.

4. Study of physiochemical parameter by using Langmuir isotherm and pseudo order kinetics.

5. Extraction of heavy metal ion from industrial Wastewater by Schiff base coated silver nanoparticle – structured complex on solid phase.

6. Analysis of metal ion by following two method :-

(1) Spectrophotometric analysis
(2) Atomic Absorption Spectral analysis

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ANNEXURE -2

REVIEW OF PREVIOUS WORK

Heavy metals are released into the environment from industrial applications, including mining, refining and production of textiles, paints and dyes. These pollutants greatly threaten the health of human populations and the natural ecosystems even at low concentration. As they do not degrade biologically like organic pollutants, their presence in drinking water or industrial effluents is a public health problem due to their absorption and therefore possible accumulation in organisms [1-5].

The toxicities of heavy metals may be caused by the inhibition and reduction of various enzymes, complexation with certain ligands of amino acids and substitution of essential metal ions from enzymes Hence, their determination in industrial effluents, various water resources, environmental and biological samples is important, especially in the environment monitoring and assessment of occupational and environmental exposure to toxic metals.[6]. A great deal of effort has been devoted to the effective removal of heavy metal ions. The traditional methods commonly used for removal from aqueous solution include ion-exchange [7], sol-vent extraction [8,9], chemical precipitation [10], nano-filtration [11], reverse osmosis [12] and adsorption [13–14].

Schiff bases derived from an amino and carbonyl compound are an important class of ligands that coordinate to metal ions via azomethine nitrogen and have been studied extensively[15]. Schiff bases have wide applications in food industry, dye industry, analytical chemistry, catalysis, fungicidal, agrochemical and biological activities.[16,17,18].

Schiff base are versatile ligands which are synthesized from the condensation of primary amines with carbonyl group these compounds are very important in medicinal and pharmaceutical fields because of their wide spectrum of biologoical activities . most of them show biological activities such as anti bacterial,antifungal,as well as anti tumour activities[19-24].

Nanomaterials are used as the novel ones to remove heavy metal ions in wastewater.Materials with the particle size between 1 nm to 100 nm are as nanomaterials. With novel size- and shape-dependent propertiesnanomaterials have been extensively investigated over a decade [25].

In recent years, the development of nanoscience and nanotechnology has shown remarkable potential for the remediation of environmental problems [26,27]. In earlier Nanoparticles formed by metal or metal oxides are another inorganic nanomaterials, which are used broadly to remove heavy metal ions in wastewater treatment. Nanosized metals or metal oxides include nanosized silver nanoparticles

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[28], ferric oxides [29], manganese oxides [30], titanium oxides [31], magnesium oxides [32], copper oxides [33], cerium oxides [34], and so on, all these provide high surface area and specific affinity. Synthesis of noble nanoparticles for the applications such as catalysis, electronics, environmental and biotechnology is an area of constant interest .

Generally, metal nanoparticles are synthesized and stabilized by using chemical methods such as chemical reduction , electrochemical techniques , photochemical reactions in reverse micelles and now days via green chemistry route . Use of plants in synthesis of nanoparticles is quite novel leading to truly green chemistry which provide advancement over chemical and physical method as it is cost effective and environment friendly easily scaled up for large scale synthesis and in this method there is no need to use high pressure, energy, temperature and toxic chemicals. Now days we are using bacteria, fungi for the synthesis of nanoparticles but use of leaf extract reduce the cost as well as we do not require any special culture preparation and isolation techniques.[35-45].

Many research groups have explored several nanoparticles for removal because of the ease of modifying their surface functionality and their high surface area to volume ratio for increased adsorption capacity and efficiency. In the last decade, magnetic nanoparticle (MNP) adsorption has attracted much interest and is an effective and widely used process because of its simplicity and easy operation [46-47].

nanomaterials including traditional inorganic nanoadsorbents and novel polymer supported composites are used to remove the heavy metal ions in wastewater treatment, due to their novel size- and shape-dependent properties, and gain the good to excellent removal efficiency[48-51]

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ANNEXURE -3

RESEARCH GAP

Removal of metals from wastewater principally achieved by the application of several processes such as adsorption, precipitation, electroplating, chemical coagulation, ion-exchange, membrane separation, and electrokinetics. Each method has been found to be limited for cost, complexity and efficiency, as well as secondary waste .

Schiff bases are prepared from the condensation of amino and carbonyl compounds and are considered as an important class of ligands that coordinate to metal ions via azomethine nitrogen and have been studied extensively. Most of the preparation of Schiff bases or their complexes is strait forward and few problems might raised. One way of overcoming the problems and to improve the techniques of analysis and facilitate the application, is to introduce a new chemical agents, which are more specific in chemical activity of the target designed, special in the application carried on traces level of various ions. Schiff bases contain multidentate coordination sites such as O and N donor atoms which have high bonding affinity towards many heavy metal ions.

Generally, metal nanoparticles are synthesized and stabilized by using chemical methods such as chemical reduction , electrochemical techniques , photochemical reactions in reverse micelles. Nanometersized materials have attracted substantial interest in scientific community because of their special properties. A nanoparticles, as a new kind of nanometersized materials are attractive because they can exhibit an array of novel and specified properties such as large surface area, potential for self assembly, high specificity, high reactivity, catalytic potential, and absence of internal diffusion resistance, which are promising to develop new or improve existing technologies in wastewater treatment.

So in recent years considerable amount of work has been done on synthesis and study of different metal nanopartical with Schiff base but literature reveals that very little work has been done on silver nanoparticle with Schiff base .

As such very little work has done on silver nanoparticle coated with Schiff base so ; I have chosen this topic for my research work .

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ANNEXURE -4

HYPOTHESIS

Literature survey reveals that Removal of heavy metal ions from wastewater and contaminated soil is a matter of great importance because of their toxic effects on the human health and on the natural environment in general. Techniques such as adsorption, ion exchange, dialysis, precipitation and extraction have been widely used to purify water containing excessive amounts of heavy metal ions.

Schiff bases are widely used in the formulating of various type of application, in medical, industrial, agricultural, et al. fields. Recently, multidentate ligand introduced in different types of complexation to modern physicochemical applications such as catalytic, optical material, dyes, luminophores as well as polymer with conductance properties to biochemically relevant studies of the Schiff bases and their complexes in the points of view such as biologically active substances, antitumor, antiviral and antifungal have given a great deal of attention. One of the important chelating agents receiving an increased interest recently due to the presences of de- fined chelating groups is Schiff bases. Schiff bases are obtained through the condensation of aldehydes or ketone with amines and contain multidentate coordination sites such as O- and N-donor atoms which have high bonding affin- ity towards many heavy metal ions .

Nanotechnology is considered as having the potential to play an important role in shaping our current environment by providing new materials,remediation/treatment techniques and sensors for monitoring purposes . Nanoparticles have attracted great interest in recent years because of their unique chemical and physical ,which are different from those of either bulk materials or single atom.
Our major aim therefore is to synthesis of silver nanoparticles using Suitable method while anchoring it with a Schiff base ligand.

Thus from above facts expected that silver nanostructured Schiff base using in removal of heavy metal ion from industrial effluent will give an starting point to the new method use in adsorption of heavy metal ions. Thus, the removal processes of heavy metals from industrial waste water and solvents contaminated by heavy metal ions are attractive for environment.

Thus this research work will encourage to do and develop something new to that extent which will be beneficial to human kind in many aspects.

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ANNEXURE– 5

RESEARCH METHODOLOGY

1. Synthesis of Schiff Base:-

Schiff Bases will be synthesized by the condensation of equimolar quantities of with aldehydes or ketones with amine in ethanol / methanol/any organic solvent.

2. Synthesis of Silver nanoparticle :–

Synthesis of silver nanoparticle by suitable method.

3. Synthesis of Schiff base coated silver nanoparticle-Schiff base is anchored on silver nanoparticle by suitable method.

4. Characterization of Ligands and silver nanocomplexes:– elemental analysis (Carbon, Hydrogen, Oxygen, Nitrogen, Sulphur) of ligands and silver Nanocomplex of Schiff base will be done by appropriate method.

5. Thin layer chromatography:–TLC will be used for checking the purity of the Ligands.

6. Magnetic moment of complexes – (By Guoy's Method)

Magnetic moment of Schiff base ligand and silver nanocomplex of Schiff Base is Measured by Guoy's method.

7. Study of physio chemical parameter: - There are following parameters:-

(i) Determination of melting point.
(ii) Conductometric studies: - conductance (Specific conductivity and Molar Conductivity) measurement will be done by digital conductivity meter.
(iii) Molecular weight determination - By Rast Camphor method

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8. Spectral studies:-

(I) IR spectra, U.V./visible spectra, NMR spectra, mass spectra and ESR study of ligand and silver nanocomplex of Schiff base will be recorded.

(II) study of surface structure of Schiff base and silver nanocomplex of Schiff base by SEM (scanning electron microscopic).

9. Extraction of heavy metal ion by adsorption phenomena :- Extraction of heavy metal ion from industrial effluent by using solid phase extraction method. Firstly, silver coated nanostructured Schiff base is to be attached with solid phase extractor (eg.silica,alumina, biomass etc) and then metal ion is adsorbed on this solid surface by adsorption phenomenon.
Extraction study on metal ion concentration , metal ion concentration in different solvents, contact time , effect of pH , Langmuir isotherm model and kinetics.

10.Analysis of Metal ion :- Analysis of Metal ion by following two methods :-

(1) Spectrophotometric analysis
(2) Atomic absorption spectral analysis

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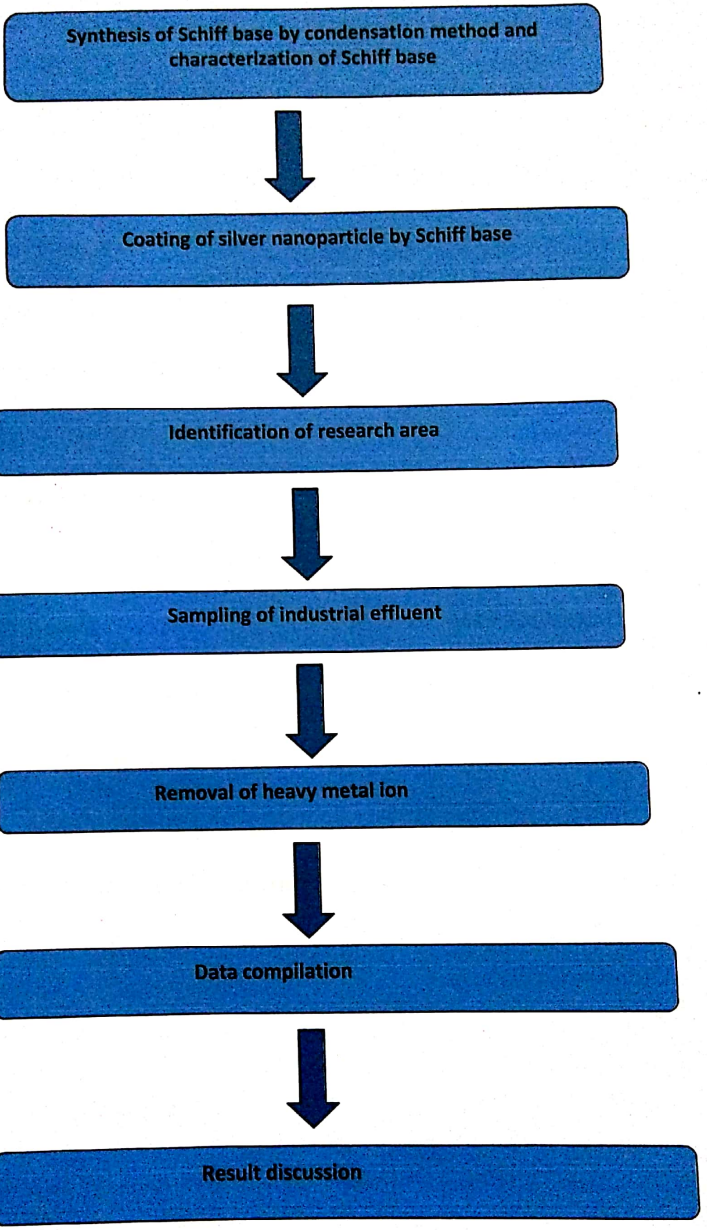
Synthesis of Schiff base by condensation method and characterization of Schiff base
Coating of silver nanoparticle by Schiff base
Identification of research area
Sampling of industrial effluent
Removal of heavy metal ion
Data compilation
Result discussion

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Expected Duration of the Work

First Year Programme:–

1. It is proposed to prepare, Schiff base ligands by the condensation of aromatic as well as aliphatic aldehydes with amines.

2. The purity of the complexes will be checked by thin layer chromatography.

3. Silver nano complex of Schiff base is prepared by using suitable method .

4. Characterization of Schiff base and silver nanocomplex of Schiff base by Elemental analysis.

5. To observe the physiochemical activities (M.P., magnetic moment, conductivity,solubility) of Schiff Base and nanocomplex.

6. Elucidation of the structure of prepared silver nano complex of ligand with the help of I.R., NMR, ESR ,Mass spectra and SEM analysis.

Second Year Programme:–

1. To observe the physicochemical activities of nanocomplex and extraction of heavy metal ion on solid phase by this complex.

Third Year Programme:–

1. Compilation of data obtained and its interpretation.
2. Publication of results and observation.
3. To prepare a thesis for the degree.

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ANNEXURE - 6

LIST OF REFERENCES

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